

# What's in a Wiki?

## Using Collaborative Technology for Developing, Reviewing, and Publishing the Systems Engineering Body of Knowledge (SEBoK)

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### Abstract.

Wikis are increasingly used in diverse settings to organize large amounts of information into concise articles and to enable broad feedback and proposed changes to that information. The BKCASE Project recently released a draft of the Guide to the Systems Engineering Body of Knowledge (SEBoK) as a wiki ([www.sebokwiki.org](http://www.sebokwiki.org)). To the authors' knowledge, this is the first time a wiki has been used as the underlying technology for a global community to develop what is hoped to be the definitive taxonomy, vocabulary, and guide to knowledge in a discipline. This paper describes the approach taken by the authors in setting up the wiki, the wiki's governance process, how authors used the wiki collaboratively to create the latest draft of the SEBoK, how the wiki is being used by SEBoK reviewers from around the world, a set of lessons learned from adoption to implementation, and the positive impact the wiki is having on both the quality of the SEBoK and the speed with which the SEBoK is maturing. Analogous efforts to create standards, reference curricula, and other community documents should consider adopting a wiki as their underlying technology together with the appropriate governance model to enable effective authoring and review.

### Background

In 2009, the Stevens Institute of Technology and the Naval Postgraduate School began the Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE™) project. The BKCASE project has four main objectives (BKCASE 2009); the first of these objectives is to create a systems engineering body of knowledge (SEBoK) which will be globally recognized by the SE community as the authoritative guide to the body of knowledge for the systems engineering (SE) discipline. The utilization of a wiki platform for development and delivery of the SEBoK is intended to support this objective, making the SEBoK globally available and providing opportunities for global review of draft versions.

### *SEBoK Development*

The BKCASE author team developed the SEBoK in four iterations labeled SEBoK versions 0.25, 0.5, 0.75, and 1.0 (see Figure 1, below). Version 0.25, a prototype, was released for limited review to 300 members of the SE community from September – December 2010. Version 0.5 is the current version of the SEBoK, and is open for global review until December 2011. [Note: This will be updated after the close of the review process in December 2011.] The next versions of the SEBoK will be released in spring 2012 and fall

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a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

2012, respectively. Version 1.0 will be the final version under the BKCASE project; it is anticipated that INCOSE and the IEEE Systems Council will take joint stewardship of the SEBoK after the release of version 1.0. [Note: This will be updated to reflect progress on SEBoK 0.75 when the paper is finalized].

The BKCASE project is staffed by almost 70 authors from 5 continents. These authors meet at quarterly meetings to discuss the project, the way ahead, and to conduct working sessions. (See Figure 1, below).

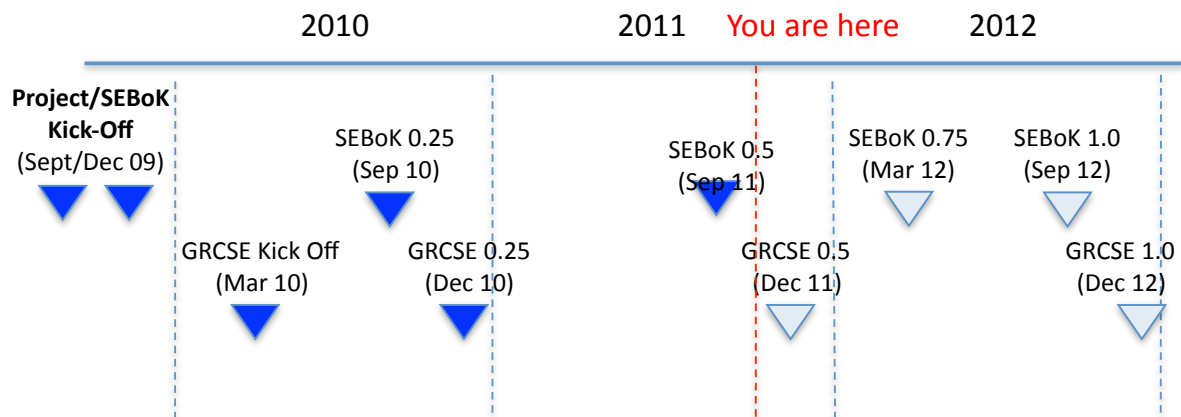


Figure 1. Development Schedule for SEBoK

## Why Wiki?

The prototype version of the SEBoK, 0.25, was release for limited review as a traditional document. This aligns with other bodies of knowledge examined, such as the Software Engineering Body of Knowledge (SWEBOK) (Abran et al. 2004) and the Project Management Body of Knowledge (PMBOK™) (PMI 2008). However, these prototype versions, which was believed to contain only a small percentage of the final SEBoK materials, was over 600 pages. In addition, there was little functionality to version 0.25; both the reviewers and the professional societies – INCOSE and IEEE CS – expressed interest in improving the functionality of the SEBoK. This led to a list of desired improvements for the SEBoK, including better navigation, improved searching, recommendations for related topics, improved linkages between content, improved definition and consistency of terminology, and easier access to references included in the SEBoK.

The authors considered several different ways in which these improvements might be implemented with consideration for the BKCASE constraints mandated by the project sponsor. First, all materials developed for BKCASE must be made available at no charge worldwide. Second, provide the broader SE community with an improved mechanism for providing feedback to ensure that the SEBoK will meet the objective of being globally accepted. In addition, as a body of knowledge, the SEBoK must have some level of stability; this is seen in the SWBOK and PMBOK, which are updated after a period of several years. Finally, it was determined that in planning for future versions of the SEBoK (post 1.0), it would be useful to provide a mechanism for collecting community feedback that would support revisions.

Several options were considered for enabling these capabilities, including the use of traditional websites/web forums hyperlinked PDF documents, and several different types of wiki. At the January 2011 workshop, the author team agreed that a wiki implementation was the most appropriate. The authors determined, however, that a traditional wiki which could

be edited freely by the public was not an appropriate model for the SEBoK. Therefore, to maintain credibility it was important to develop within a wiki environment that could be restricted (or opened), as appropriate, and provide a variety of access control options. Balance between an open and collaborative environment for publication and a restricted environment during development is an important aspect of using wiki technology. After examining many different options, the team agreed to utilize the MediaWiki engine, along with the implementation of many different access controls and technical adjustments that were made as needed to create a viable and appealing environment for the users throughout the project life cycle.

## **Wiki Development of a Body of Knowledge**

SEBoK 0.5 was developed primarily between April and September 2011. The review comments from the 0.25 version were incorporated into the revisions.

Again, it was critical that the wiki be a ‘closed’ environment during development – allowing the author team a space to iterate draft materials without outside alterations. However, access had to be controlled without losing many of the benefits of a wiki environment, such as the ability to see updates in real time worldwide and to provide feedback on others’ work. Also, as the SEBoK does represent a body of knowledge, it was critical that there be some stability, at least in the architecture, to enable author to improve integration between related elements of the SEBoK. To that end, a mixture of technology-based and process-based solutions was used during the development.

### ***Development Control***

For the development of SEBoK 0.5, the ability to view, edit, and create accounts was restricted. This created a wiki environment which was private – accessible only to the author team. However, once an author (or other authorized user) was inside the space, all of the other functionalities were available - authors in the wiki were able to edit any and all pages. However, the BKCASE author team’s staffing allocation did not include all authors working on all articles at all times. In order to reconcile author assignments and open access, the BKCASE team agreed to a process for controlling development. Authors were on their honor to directly edit only the areas of the wiki assigned to them. They were instructed to provide feedback on any other aspects of the wiki using the MediaWiki discussion feature. This allowed authors some control/autonomy during initial drafting, while still permitting and encouraging all authors to provide feedback on any article.

### ***Configuration Management***

To ensure some stability of the architecture of the wiki, structural changes to the wiki – the creation, deletion, or renaming of pages – were restricted to a limited number of leadership members. However, because it was important for authors to take ownership of the different parts of the wiki, a fairly traditional configuration management process was implemented to allow them to propose architectural changes. The process included initial approval by a peer group – working on the same group of pages – before a change was sent to the configuration management board.

### ***Structure***

SEBoK 0.5 is the rough equivalent to 1,000 pages in a traditional document. Though breaking the SEBoK down into individual wiki pages improves manageability, a collection of web-based pages is not sufficient for a body of knowledge. To remedy this the BKCASE

authors identified a way to organize the information contained in the SEBoK into three main units: parts, knowledge areas, and topics. A “part” is the highest order grouping in the SEBoK. There are seven parts in version 0.5; the parts cover introductory materials for the SEBoK, the nature of systems, an overview of SE, the applications of SE to different types of systems, the utilization of SE within an organization, the interaction of SE with other disciplines, and a collection of real world SE examples.

Each part consists of a collection of related knowledge areas (KAs). “Knowledge Area” is a term commonly found in bodies of knowledge (e.g. the SWEBOK and PMBOK™) that is used as an organizational unit for related information. There are 32 KAs in version 0.5; examples include “Types of Systems”, “System Definition”, and “Service Systems Engineering”. A knowledge area, in turn, consists of a set of topics. A topic is the lowest organizational level of the SEBoK and is a concept that defines specifically related knowledge. There are 115 topics in version 0.5; examples include “Classifications of Systems”, “System Integration”, and “Software Engineering and Systems Engineering: Similarities and Differences.”

## Wiki in Review

[Note: This will be updated upon the close of the review process]. SEBoK 0.5 was released for unlimited worldwide review on September 19, 2011 and will be available for review until December 15, 2011. During the development phase of the wiki, it was critical that only a small number of individuals access the wiki at all, but that those individuals have almost complete control. During the review period, the opposite is true: anyone on the planet should be able to access the wiki, anyone who wants should be able to provide comments, but the actual content itself – the pages – must be left untouched to enable a consistent review.

For the review period, the wiki was changed from “private” to “public”. However, in order to provide a stable version for review, it was critical that changes not be made. This required protection of all pages of the wiki. While this is a standard feature in most wikis, the BKCASE project had to use a higher level of protection to ensure that even the authors would not be able to make changes during the review period.

As mentioned, a primary reason for utilizing wiki technology was to provide an easy mechanism for the community to provide feedback – and to enable the individuals to see the feedback provided by others. To this end, the LiquidThreads – threaded discussion – extension has been used for SEBoK 0.5. This enables anyone who desires to provide reviews the ability to input their feedback and review and respond to the feedback of others.

The BKCASE team had several major areas of interest for the review – to that end, they developed a series of prompts that are incorporated into the discussion for each page. These may be seen in Table 1. The rationale for providing some structure for feedback was to ensure that reviewers are aware of the main areas of concern, while also enabling flexibility in their responses (e.g. the “Open Discussion” thread).

Table 1. Discussion Prompts for Content Review of SEBoK 0.5

Thread Title	Prompt
Integration	A goal of the SEBoK is to ensure that concepts are discussed consistently throughout. Please use this discussion thread to provide feedback on integration of the concepts in this article – both what

Thread Title	Prompt
	worked well and what can use improvement.
Multiple Perspectives	A goal of the SEBoK is to provide guidance to the many varying perspectives on each topic. Please use this discussion thread to provide feedback on the perspectives provided and additional perspectives that can be considered for this topic. Please suggest references in the "References" discussion to support these additional perspectives.
Terminology	A goal of the SEBoK is to ensure that terms are discussed consistently. Please provide any feedback specific to the terminology used in this article – both what worked well and what can use improvement.
References	The SEBoK is designed to provide pointers to a variety of relevant works within the systems engineering community for a given topic. For version 0.5, the author team acknowledges that more diversity of references is still needed. Please provide your feedback on references here, specifically what additional references should be considered for future incorporation.
General Content	Please provide your general impressions of the article's content and usefulness, along with your recommendations for improvement here.
Open Discussion	Please place all other comments here.

In addition to ensuring that the SEBoK review solicits the desired feedback, the review approach also provides an opportunity for the BKCASE authors to get feedback on their materials in real time to begin working on the draft of SEBoK 0.75. When the review period for 0.5 is complete, the authors will provide a summary of each discussion thread in the wiki along with an adjudication – the actions taken by the authors in response to the feedback. This will enable a transparent adjudication process while allowing reviewers to understand how their efforts are shaping the SEBoK.

[Note: This will be updated to reflect key lessons learned from the review period – including level of community response, level of interaction in the feedback structures, etc. At the time of final paper submission, version 0.75 will have been released.]

## Publication and Beyond

It is anticipated that the wiki implementation will be used for the development and review of SEBoK 0.75 and for the development and final delivery of SEBoK 1.0 in fall 2012. As previously mentioned, it is anticipated that INCOSE and the IEEE Systems Council will take stewardship of the SEBoK at this time. It is believed that the professional societies will maintain the wiki delivery of the SEBoK, as it will provide a mechanism for collecting and archiving community feedback in real time that will be available for future revisions.

As a body of knowledge, the SEBoK will likely maintain permission controls similar to those currently implemented – namely that for each published version, all will be able to comment, while few will be able to edit. Again, the rationale for this is that a body of knowledge requires some level of stability over time. However, it is hoped that due to the manner in which community feedback is collected, the professional societies will be empowered to

make updates to the SEBoK more frequently than other bodies of knowledge. (For example, the SWEBOK was published in 2004 and is only now undergoing its first revision.)

A final advantage to maintaining wiki implementation is that while the content of the SEBoK needs to be somewhat stable, the comments do not need to be. In fact, in utilizing the comment functions, it is possible for members of the community to recommend additional view points, new literature, or introduce an emerging area of research. Again, this will make the SEBoK more valuable to the community as a whole, even while maintaining the consistency required of a body of knowledge.

## **Conclusions**

Wiki technology is inexpensive – “free” in the case of MediaWiki– easy to set up, easy to use, and enables large, geographically dispersed groups to work on complex projects in real time, with the capability for instantaneous two-way communication viewable by a limited set of users or the public. It can be tightly controlled so that only certain people can even see the information or it can be completely open, with anyone having the ability to edit. The BKCASE author team has successfully utilized wiki technology as a collaborative tool; it is believed that this tool will shape the way that the SE community shares information and interacts going forward.

## **Possible Future Research**

The SEBoK is an example of the utilization of a wiki for developing publications. How else are they being used? For example, in disaster response, communications between first responder organizations and development of a common operating picture are consistently referenced as recurring a problem. Could wiki tech provide a fast and easy way for updates when physical infrastructure survives? Could you wiki technology be used for enabling communication in and simultaneously documenting a SE effort? The possibilities are intriguing – future research efforts may focus on how this type of Web 2.0 technology may be best employed in practice.

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## **Biography**

**Nicole Hutchison.** Ms. Hutchison is a Staff Researcher for the Systems Engineering Research Center (SERC), supporting the Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE) project, specifically wiki implementation, and a technical leadership initiative for the Defense Acquisition University.

Prior to joining Stevens, Ms. Hutchison spent five years at Analytic Services Inc., supporting initiatives of the Departments of Defense, Homeland Security, and Health and Human Services as well as the National Guard and the Pacific Air Forces (PACAF). Ms. Hutchison also served at the Louisiana Family Assistance Center in Response to Hurricane Katrina.

Ms. Hutchison holds an ME from Stevens Institute of Technology, an MS from Georgetown University, and a BS and a BA from Virginia Tech.

**Art Pyster.** Dr. Pyster has more than thirty years of experience as a successful executive, researcher, engineer, educator, and manager in government, industry, and academia. He has created, delivered, acquired, or operated numerous leading edge systems and technologies in telecommunications, aerospace, defense, air traffic control, and information technology domains.

Currently, Dr. Pyster is Deputy Executive Director of the DoD Systems Engineering Research Center (SERC) (since 2008), a University Affiliated Research Center. Currently, he leads the Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE) project. He also serves as a Distinguished Research Professor at Stevens Institute of Technology (since 2007), where he teaches and conducts research on systems engineering, software engineering, and enterprise systems. Dr. Pyster is also the Director for Academic Matters for the International Council on Systems Engineering (INCOSE) (since 2010), a member of the INCOSE Board of Directors (since 2008), and an INCOSE Fellow.

**Steph Enck.** Stephanie Enck is a research assistant at the Naval Postgraduate School's Systems Engineering Department. Her research interests and project coordination efforts for the department stem from working on various SE education initiatives and the BKCASE effort. The combination of these projects has her engaged in communication outreach, intellectual property management, budgeting, and co-management of various online project tools. She has a Bachelor of Science in Communication, successful sales and marketing management experience, and served as a volunteer for the Army community before joining the NPS SE department in 2007.

**Hans-Peter de Koning.** Need your bio.